

# Delivering carbohydrates for exercise with dairy – the application of lactose in sports nutrition

Gareth A. Wallis, PhD  
Professor of Exercise Metabolism and Nutrition

Head of Research  
School of Sport, Exercise & Rehabilitation Sciences



UNIVERSITY OF  
BIRMINGHAM



# Disclaimer

In the last 5 years research funding or honoraria from the following organizations has been received:

- Novo Nordisk Foundation (charity)
- Dunhill Medical Trust (charity)
- Gatorade Sports Science Institute (industry)
- US Department of Defense (government)
- Dairy Management Inc. (industry)
- Volac International Ltd (industry)

# Outline

- Dairy as a carbohydrate source
- Lactose as an energy source
- Recovery from exercise
- Summary and practical considerations



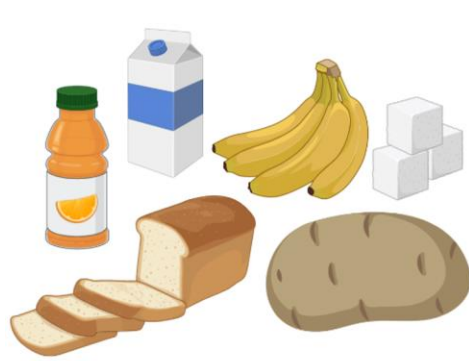
# Why is it important to eat or drink dairy?

The Dairy Group provides many nutrients including:

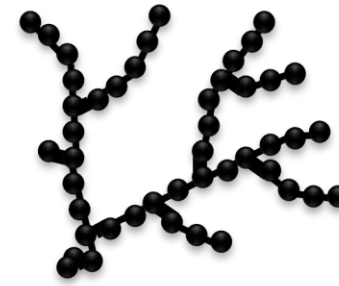
- Calcium
- Phosphorus
- Vitamins A, D & B12
- Riboflavin
- Protein
- Potassium
- Zinc
- Choline
- Magnesium
- Selenium



# Dietary carbohydrates



amylose  
starch



amylopectin  
starch

lactose



galactose



maltose



glucose



sucrose



fructose



# Lactose content of various dairy products



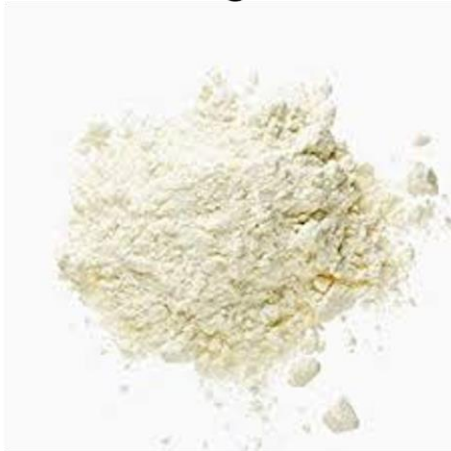
4.7-5.0 g/100 ml



3.3-6.0 g/100 ml  
+sucrose/glucose



4.5-6.0 g/100 g



3.5 g/100 g



2.5-3.0 g/100 g



0.3-2.4 g/100 g



UNIVERSITY OF  
BIRMINGHAM



# Dairy-based products in sports nutrition



**25 g carbohydrates  
(mainly lactose)**



**22 g carbohydrates  
(hydrolyzed lactose)**



**51 g carbohydrates  
(lactose, sucrose)**



# Dairy as a carbohydrate source for athletes

We know very little about habitual lactose consumption in athletes and recreationally active individuals

Given the suitability of dairy foods or dairy-derived products to meet nutrient needs for athletes/active people, its quite possible lactose has varying degrees of prominence in the diet

Nonetheless, lactose is rarely specifically considered in the context of carbohydrates in the athlete diet, perhaps due to a paucity of research

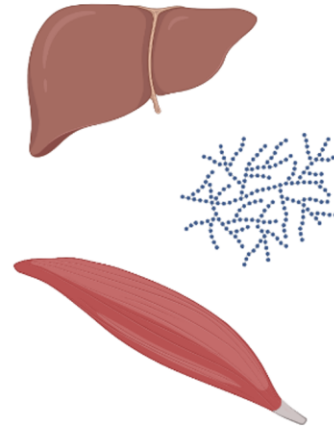


# Milk sugars – a carbohydrate source?

Energy source for  
exercise



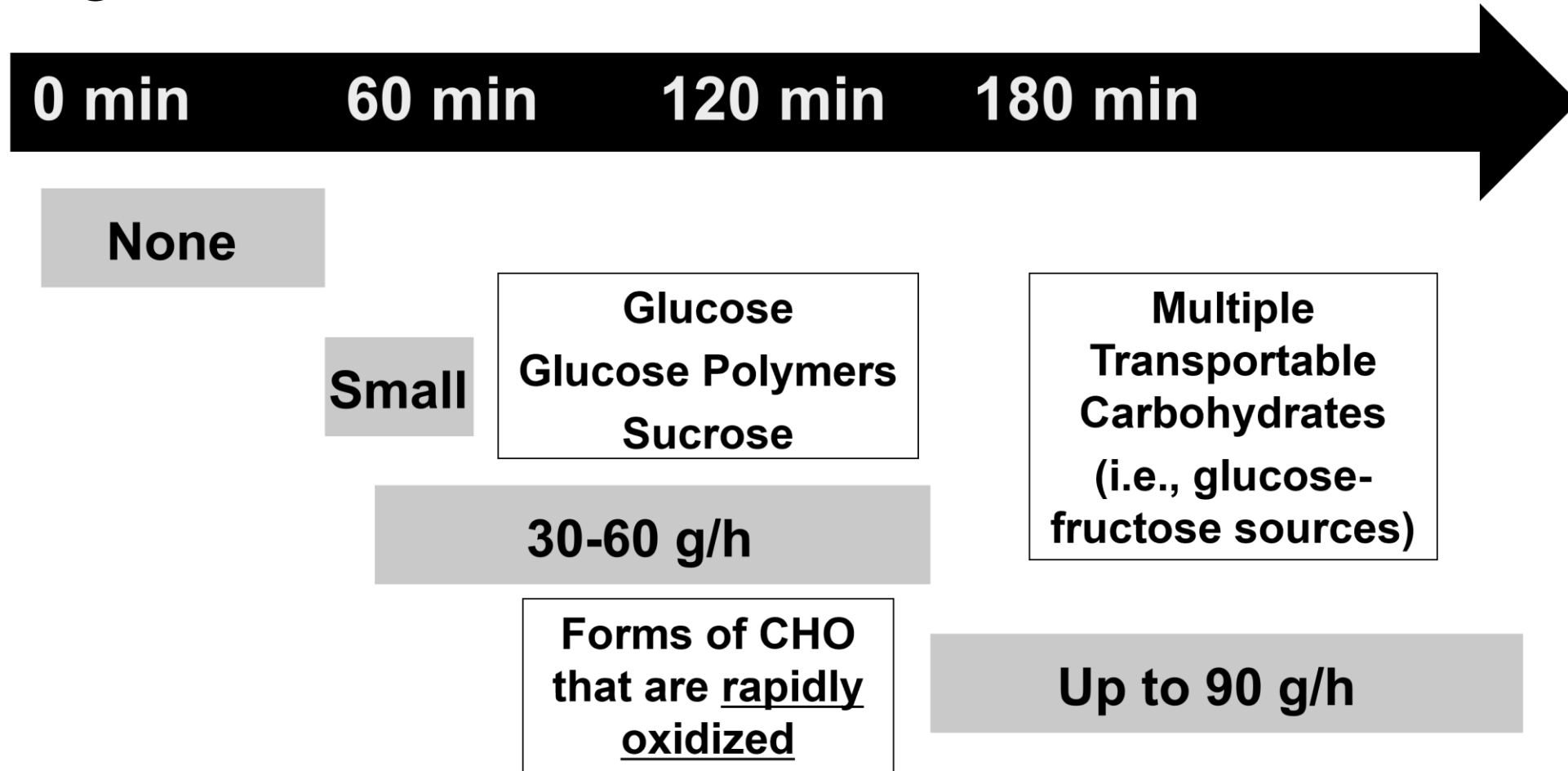
Optimising glycogen before  
and after exercise



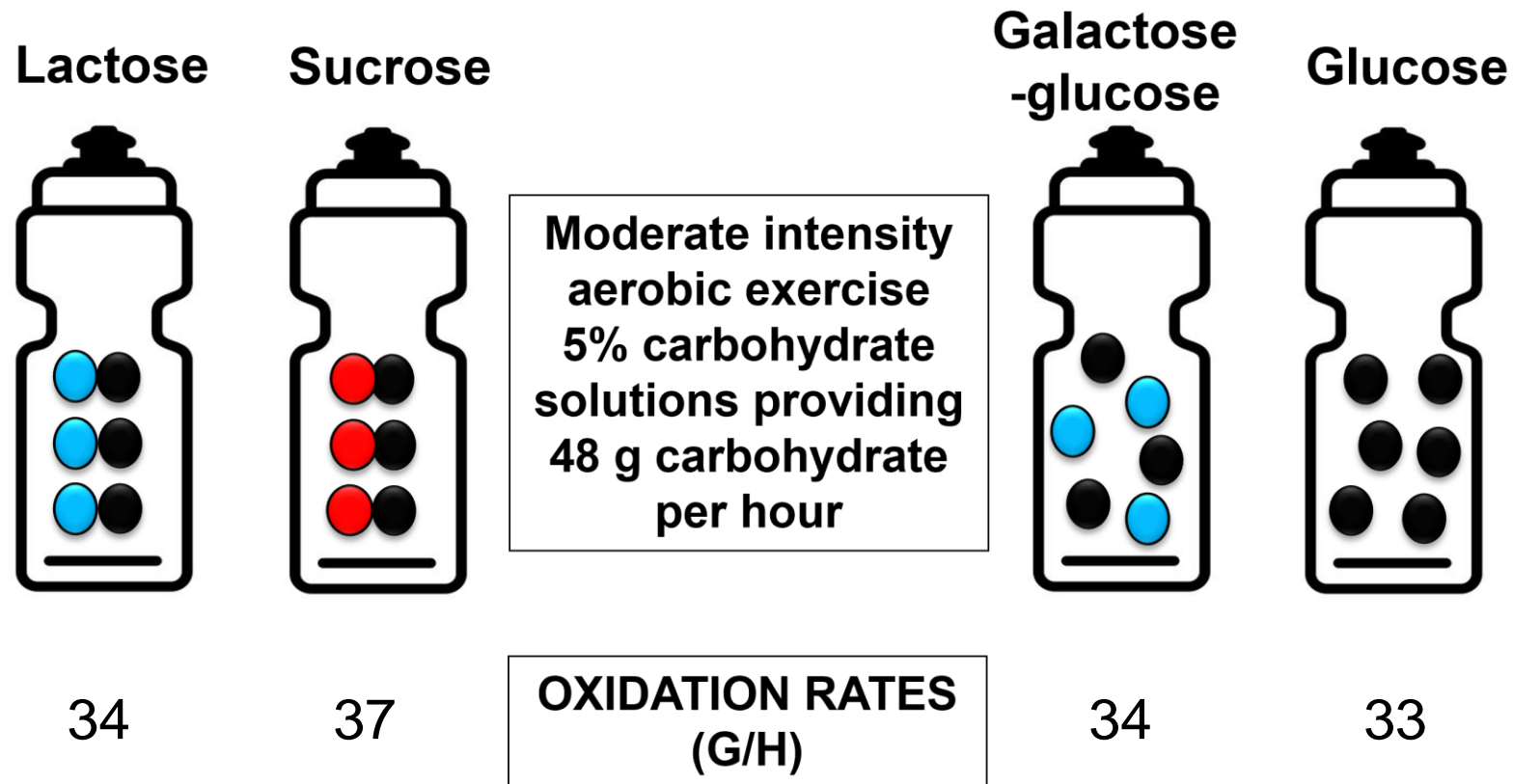
# Outline

- Dairy as a carbohydrate source
- Lactose as an energy source
- Recovery from exercise
- Summary and practical considerations

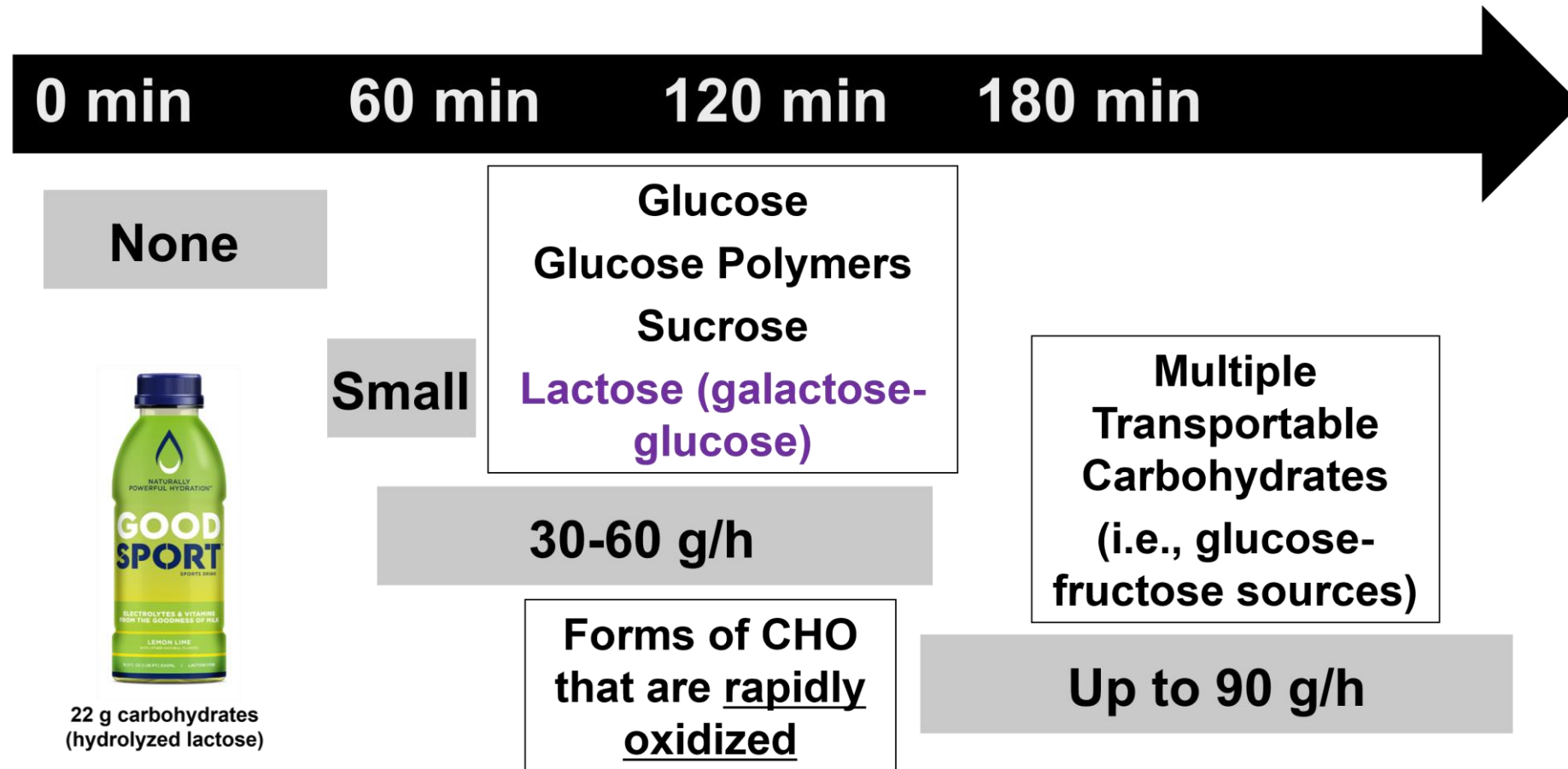
# Recommended carbohydrate intake for athletes during exercise



# Are ingested milk sugars used at a fuel source during exercise?



# Recommended carbohydrate intake for athletes during exercise



# Lactose as an energy source for exercise

Lactose clearly has the potential to act as a viable energy source for consumption during exercise

We haven't directly studied the subsequent performance effect of lactose

Prior albeit limited evidence suggests equivalent performance benefit of low-fat milk versus carbohydrate-based drinks

Reasonable to conclude that lactose (delivered by dairy or other means) can form part of a pre- or during exercise carbohydrate feeding regimen



# Outline

- Dairy as a carbohydrate source
- Lactose as an energy source
- Recovery from exercise
- Summary and practical considerations



# Recovery from exercise

Milk/flavoured-milk well studied in post-exercise context.

Generally favourable for muscle glycogen synthesis and endurance recovery.

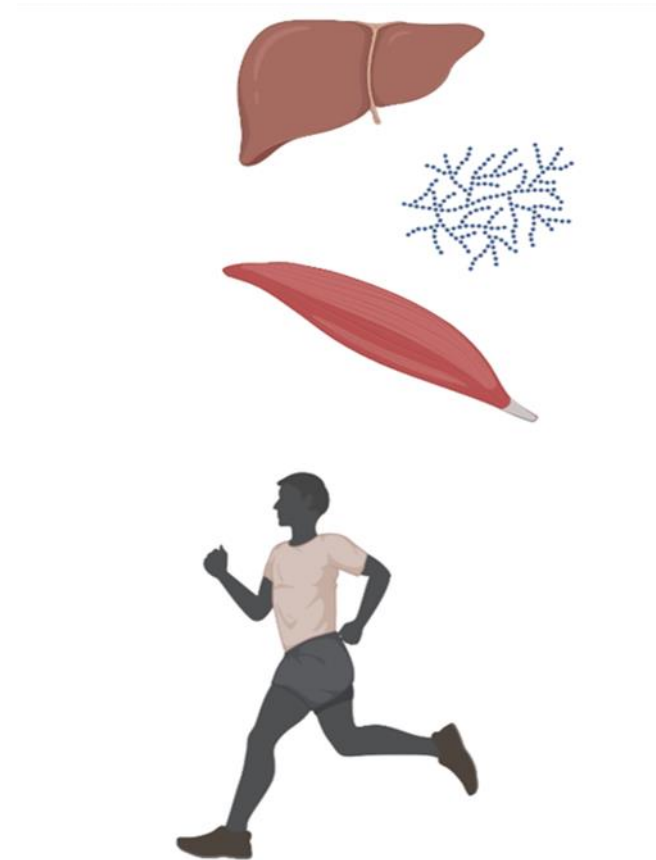
Odell & Wallis, Int Dairy J, 116:104970, 2021

Beginning to understand more about how milk sugars specifically affect glycogen synthesis

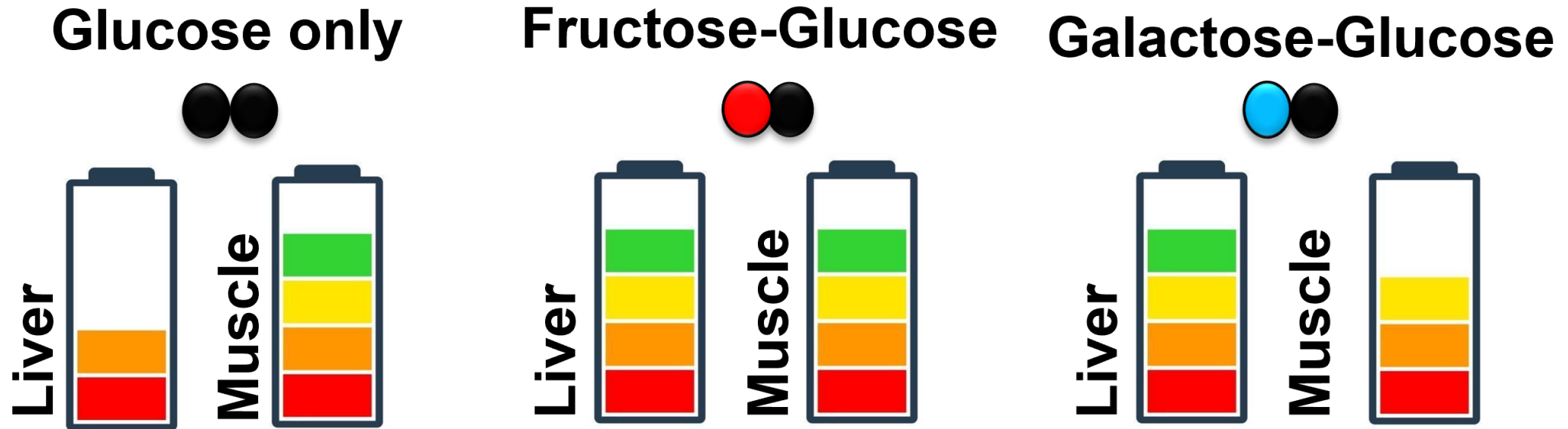


UNIVERSITY OF  
BIRMINGHAM

Optimising glycogen before  
and after exercise

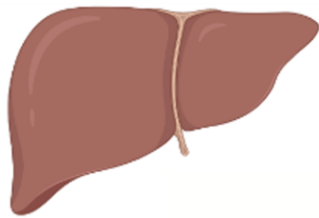
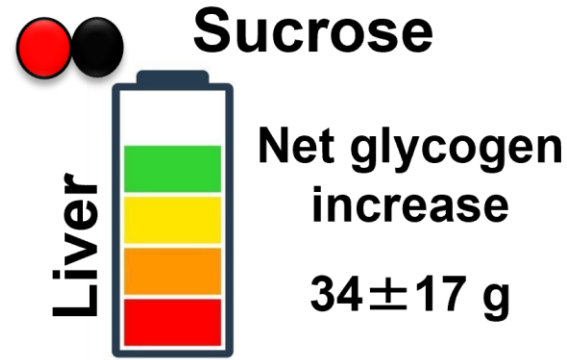


# Short-term recovery of liver and muscle glycogen after exercise

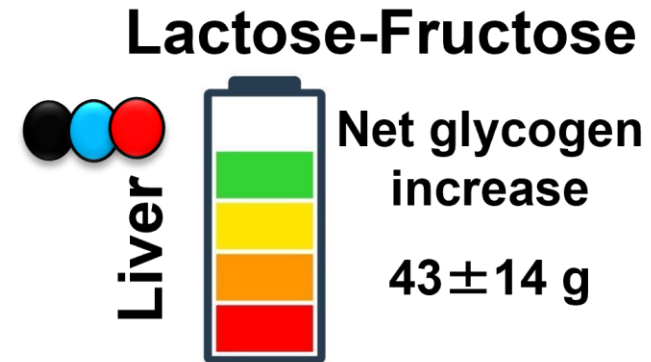


Does adding galactose to fructose further stimulate liver glycogen storage?

# Does adding galactose to fructose further stimulate liver glycogen synthesis?



Glycogen reducing exercise bout.  
4 h recovery with carbohydrate solutions providing 1.5 g/kg/h.  
Protein ingestion (0.4 g/kg) at 0 & 2 h into recovery.  
Liver glycogen by MRI/MRS  
(n=10)



Lactose-Fructose v Sucrose;  
~26% difference;  
 $P = 0.098$



# Recovery from exercise

Lactose alone or within dairy-based products clearly has the potential to support recovery of carbohydrate energy reserves after exercise

Ideal short-term recovery nutrition would likely include a blend of glucose, fructose and galactose sugars to support liver and muscle glycogen synthesis (and some protein [critical if predominantly milk sugars])



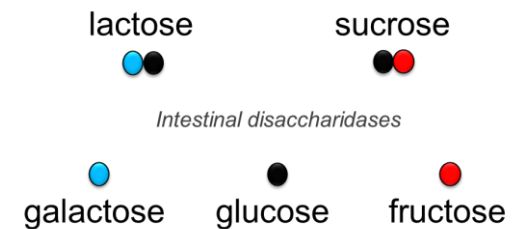
Fluid = 0.56L

Energy = ~440 kcal

Protein = ~15 g

Fat = ~21 g

Carbs = ~45 g



# Outline

- Dairy as a carbohydrate source
- Lactose as an energy source
- Recovery from exercise
- Summary and practical considerations





# Summary

Lactose probably does feature to varying degrees in the diets of athletes and other active individuals

We have shown lactose to be a viable fuel source for exercise which widens the choice of food and drinks to support carbohydrate needs before and during exercise (for tolerant individuals)

Milk sugars can support short-term recovery of carbohydrate energy reserves after exercise; this is probably optimized when ingested alongside a protein source (e.g., milk) and a fructose source (e.g., flavored milk)



# Thank-you for listening

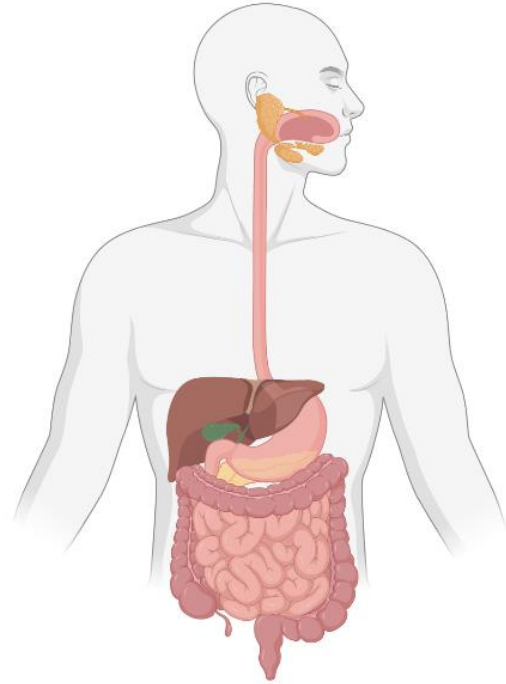
The work presented here reflects contributions from many colleagues and collaborators, but Dr Tim Podlogar, Dr Ollie Odell, Dr Brandon Shad, Dr Sam Impey, and Professor David Rowlands (Massey, NZ) were particularly integral.



UNIVERSITY OF  
BIRMINGHAM



# Considerations for lactose in sports nutrition



Low FODMAP  
maldigestion  
and/or  
intolerance



# Digestion, absorption & metabolism

